

problem. Noden reviews the migration and differentiation of neural crest cells. What determines their pathway and final state? He concludes that this is largely determined by interactions with their environment, and while proteoglycans may be involved, the nature of the interactions is unknown. So too are the interactions in the formation of nerve connections so well analysed by Gaze. He considers three main classes of mechanism for the establishment of the ordered pattern of connections between retina and tectum and points out some of the confusion concerning the concept of neuronal specificity. While concluding that neurones carry markers, he points out that there is no evidence that selective adhesiveness plays any role in the process of ordering.

Steinberg reviews his differential adhesion hypothesis which can account for the sorting of different cell types when they are mixed together. In this theory, the cells are assigned a surface energy which varies as a scalar and which can be used to predict the behaviour of mixtures at equilibrium. The relation of this parameter to specific ligands is discussed. Lilien and colleagues approach the problem in terms of the molecules that may specifically interact, in the classic lock and key fashion of enzyme and substrate, to provide cell adhesion. Evidence of the role of sugars is presented, based largely on aggregation studies. Models based on ligands and receptors are attractive but unproven. This is particularly clearly seen from the review of Rosen and Barondes on the cellular slime moulds. While Gerisch's group have

evidence for two types of attachment sites, their own work implicates carbohydrate-binding proteins, lectins, and the relationship between them is not known. The best evidence for an aggregation factor comes from sponges, which are reviewed by Turner, but even here, the distinction between cell adhesion and cell recognition is not clear. The complexity of such systems is further emphasized by Curtis, who invokes diffusible morphogens which can diminish the adhesiveness of unlike cell types. My own conclusion was that while evidence for molecular specificity in cell adhesion is available, it is by no means established. One should remember that many types of cells can stick to one another, thus weakening the analogy with systems such as antigen-antibody and enzyme-substrate, that are our models for specificity.

The emphasis in this volume on cell adhesion, makes the title somewhat misleading. There is a large class of interactions in development, hardly considered here, which are concerned with the specification of cell state. Moreover, specific interactions do not require specificity at the cell surface. It is possible that many of the observed phenomena may involve cell-to-cell communication via gap junctions between the internal contents of cells.

The volume can be recommended to all cell biologists as well as to advanced students. The confusion will do them good.

Lewis Wolpert

Biomathematics and Cell Kinetics

Developments in Cell Biology, Volume 2

Edited by A.-J. Valleron and P. D. M. Macdonald
Elsevier/North-Holland; Amsterdam, New York, 1978
xviii + 432 pages. \$67.25, Dfl 138.00

This volume contains papers presented at a workshop held in the University of Paris in early 1978. The papers are divided into seven categories: general mathematical and computer methods; modelling the cell cycle; development, differentiation and ageing;

diurnal rhythms; haemopoiesis models; tumour models; and flow cytometry methods. Basically, the papers explore the problem of describing in mathematical terms, and hence of predicting the properties of, an assembly of dividing cells of one type, first of all

taking into account merely that the cells are asynchronous, and that there may be correlations between the life expectancies of mother and daughter, or of sister cells. Further complications, such as senescence, differentiation, and diurnal rhythms, are then considered as perturbing factors.

This approach to cell biology is very valuable because of the important practical implications. For instance, irradiation and most cytostatic drugs preferentially kill cells in some phases of the cell cycle, and delay transitions in other cells to a greater or lesser extent. This often introduces a partial synchrony, so that a second treatment acts on a population of cells with a different distribution among the phases of the cycle from the original population. Clearly, it is important to be able in some way to take account of this in any manipulation of cell types. However, from the biochemist's point of view, it is unfortunate that most of the models presented in this volume use only the descrip-

tive G₁, G₂, S and M labels for the phases. (Even here, one may note a stochastic model proposed by Hopper, which avoids the need to introduce the concept of a 'G₀' phase, which there is at present no physical means of identifying.) Only one paper makes any attempt to relate the phases to biochemical events, such as DNA replication; this is the satisfying discussion of Control of Cell Growth and Division by Alberghina and Mariani.

For most people one imagines that the chief value of the book will lie in the long and critical review of flow microfluorimetry by Zietz and Nicolini, who discuss this very important new technique for studying cell kinetics and biopsy material both in terms of the available instruments, and of the basic nucleic acid and protein chemistry which underlies the methodology. They also discuss the necessary mathematical techniques. To a non-specialist this review appears to be very helpful indeed.

J. H. Ottaway

Progress in Industrial Microbiology Volume 15

Edited by M. J. Bull

Elsevier; Amsterdam, New York, 1979

viii + 298 pages. \$63.00, Dfl 129.00

This volume in the established series contains five chapters on diverse topics ranging from industrial enzymology, through microbial genetics to marine microbiology.

Taking these chapters in turn, the first on microbial β -glucanases by G. Halliwell mainly consists of a detailed review of cellulases, their composition, action and regulation. This is a good up to date review of a most complex area. Commercial scale production of glucose from cellulose using such enzymes would be highly desirable.

K. Venkatasubramanin and W. R. Vieth present a short, but important review of immobilised microbial cells. Whether in the long term these can hold off the competition from immobilised enzymes remains to be seen. Both types of system have advantages and disadvantages. Certainly it is tempting at present to use immobilised cells for many applications, but the

biochemist's rôle should increase in the future.

W. M. Fogarty and C. T. Kelly present a long, comprehensive, most detailed and finely documented review of the distribution and characteristics of starch degrading enzymes. Volume 16 of this series is expected to publish Part II of this chapter, on biosynthesis, regulation and production of these enzymes.

Yeast genetics in industry by J. R. Johnston and H. Oberman is a most welcome review, related to the brewing and other industries. There is a strong interest now in this field in relation to genetic engineering techniques, and this review from Strathclyde and Lódz is timely and well written.

The final chapter on the microbiology of interfaces in the marine environment by P. S. Meadows and J. G. Anderson was justified especially by the editor in his preface, because of the economic implications of marine microorganisms. Certainly the